1. 0 Introduction

1.1 Purpose and Supporting Documents

In 2002, the Office of Environmental Management (EM) of the Department of Energy (DOE) published the *Top-to-Bottom Review of the EM Program*, which identified several challenges facing the DOE-EM Program, revealed by cost and schedule estimates determined by an independent review team. Later that same year, EM established a set of corporate projects to change the way EM and DOE conducts business. Since the *Top-to-Bottom Review* was issued, EM has taken aggressive action to accelerate risk reduction, instead of focusing on risk reduction. In order to support this approach, the Department issued DOE Policy 455.1, *Use of Risk-Based End States* in July 2003.

The purpose of the policy and its complementary guidance is to ensure cleanup is focused and achieves clearly defined, mutually agreed-upon, and technically defensible end states that are protective and sustainable, and reflect the planned future use of the property. The *End State Vision* (ESV) goal is to improve the effectiveness and accelerate the cleanup process.

The *Savannah River Site* (*SRS) End State Vision* was developed according to Department of Energy (DOE) Policy 455.1, *Use of Risk-Based End States*, the *DOE End State Vision Guidance*, and the *DOE End State Vision Guidance Clarification*.

The *SRS End State Vision* depicts appropriately protective and sustainable site conditions by which current regulatory and other parameters can be described, evaluated, and contrasted. It is intended to support informed decision making regarding responsible site cleanup.

The following are the information/data sources used in the development of the *SRS End State Vision*:

- *SRS EM Program Performance Management Plan* (PMP) – describes the strategy to achieve accelerated cleanup and risk reduction at SRS. It includes the scope, schedule, cost, roles and responsibilities, milestones, end state descriptions, performance metrics, and actions required to achieve cleanup by the end of FY 2025.
- *DOE Report to Congress: Planning For The Future, An Overview of Future Use Plans at Department of Energy Sites* – describes the future use planning process and the future use plan for SRS. It represents the formal response to the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 1997 requirement to submit future use plans to Congress. The *SRS Future Use Plan* is the result of a series of public meetings and the SRS planning process. It provides the land use requirements for the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedy selection in the cleanup process.
- *SRS Long Range Comprehensive Plan* -- describes the framework for integrating SRS missions and infrastructure with ecological, economic, cultural and social factors in a regional context.
- *SRS Ten Year Site Plan* – integrates the site's programs' technical requirements, performance measures, budget, and cost projections within the 10-year window for all DOE programs at SRS.
- *SRS Strategic Plan* – updates SRS vision and strategic goals in partnership with site contractors and support agencies in achieving the DOE goals of: Nuclear Weapons Stockpile Stewardship, Nuclear Materials Stewardship, and Environmental Stewardship.

- *Federal Facility Agreement* – directs the comprehensive SRS remediation through an agreement among United States Environmental Protection Agency (USEPA), South Carolina Department of Health and Environmental Control (SCDHEC) and DOE, as required by the CERCLA and the Resource Conservation and Recovery Act (RCRA).
- *Site Treatment Plan* – plans for the treatment capacities and technologies to treat mixed waste as required by RCRA and the Federal Facility Compliance Act. The plan is to be reviewed by SCDHEC, in consultation with the USEPA, each year.
- *DOE Savannah River Operations Office (SROO) Comprehensive Cleanup Plan* – advances the SRS area closure approach by presenting the current or identified scope of SRS environmental restoration and deactivation and decommissioning projects in the schedule sequence to meet the requirements to achieve an Area Record of Decision (ROD) that documents the complete cleanup of an area.
- *Safety Analysis Reports* – document the adequacy of a safety analysis for a nuclear facility to ensure that the facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations.
- *Environmental Impact Statements (EIS)* – describe actions that may significantly affect the quality of the human environment as required under the National Environmental Policy Act (NEPA). The EIS requirement includes the public in the federal agency decision-making process. Major actions generally are those actions that require substantial planning, timing, resources, or expense.
- *Environmental Information Documents* – provides environmental information/data developed as background technical documentation for the DOE's Environmental Impact Statement on waste management activities at SRS.
- *Administrative Record File* – maintains the documents for the complete Administrative Record, post-Record of Decision primary and secondary documents and reports for the DOE-preserved repository, throughout the duration of the FFA, and for a minimum of 10 years after the termination and satisfaction of the FFA,.
- *SRS EM Integrated Deactivation and Decommissioning Plan* – communicates key elements of the path forward for SRS closure; provides a basis for planning, implementing, and decommissioning method for closure of EM facilities and waste sites; and serves as a repository of supporting information for closure of facilities, waste tanks, and waste sites in hard copy and electronic form.
- *Annual Environmental Reports* – present summary environmental data that characterize site environmental management performance; confirms compliance with environmental standards and requirements; highlights significant programs and efforts; and assesses the impact of SRS operations on the public and the environment.
- *Land Use Controls Assurance Plan for the SRS* – assures long-term effectiveness of land use controls (LUC) at contaminated SRS waste units listed in the FFA undergoing remediation pursuant to CERCLA and/or RCRA, for which LUCs were selected as part of the final corrective/remedial action.
- *Savannah River Site's Cold War Built Environment Cultural Resources Management Plan* – applies only to the site's National Register of Historic Places for Cold War Built historic properties and outlines the vision, strategies, and planning for the evaluation, management, mitigation, and preservation of these properties. It does

not pertain to cultural resources associated with the site's pre-history and pre-Federal history.

1.2 Organization of the Report

Chapter 1 briefly discusses relevant background objectives and drivers for the *SRS End State Vision*; provides a user's guide that describes the relationship and integration of appropriate text and tables, briefly discusses status of the site's mission and cleanup strategy. Chapter 2 addresses the SRS in a regional context by defining the human and ecological land use surrounding the SRS. Chapter 3 provides information on the physical and surface interface, land use and ownership and site demographics at the overall site level. Chapter 4 provides hazard-specific discussion, which are presented at the individual watershed and area scale. Appendix A (*Regional and Site Maps*) supports the information and data presented in Chapter 2 and 3. Appendix B provides SRS Alternative End States and recommendations, with subsequent appendices providing complimentary information relative to the *SRS End State Vision* objectives. Appendix C describes the regional planning initiatives developed with the Central Savannah River Area (CSRA) planners. Appendix D provides regulatory support documents and agreements. Appendix E is a brief summary of long-term stewardship. A list of references is provided in Appendix F. Appendix G gives a summary of land use, risk, and how the cleanup decision process works. Public comments from previous versions of the *SRS Risk-Based End State Vision* and responses to those comments are provided in Appendix H. Appendices I, J, and K support the information and data presented in Chapter 4.

Appendix K is unique to the hazard classes of inactive waste units and EM facilities. Due to the large number and similarities of hazards that comprise these hazard classes, "typical" hazard type Conceptual Site Models (CSMs) have been developed to represent multiple and similar waste units or EM Facilities.

The *SRS End State Vision* (ESV) fully meets the intent of the guidance; however, a tailored approach has been implemented to meet the data requirements for the *End State Vision*. The ESV is designed to define and categorize hazards in such a manner that all stakeholders can understand the hazard and what actions are being taken to reduce and/or eliminate the hazard.

SRS hazards are organized into five major classes. The five classes are further subdivided into fourteen categories:

- **Nuclear Materials:** plutonium, uranium, spent nuclear fuel, and tritium.
- **Radiological Waste:** High Level Waste (HLW), Transuranic (TRU) waste, Low Level Waste (LLW) and Low-Level Mixed Waste (LLMW).
- **Non-Radiological Waste:** hazardous and sanitary waste
- **Inactive Waste Units:** contaminated soil and groundwater
- **EM Facilities**: nuclear, radiological, other industrial facilities and high-level waste tanks

Hazard types are identified individually and physically depicted/described in the following geographic hierarchy:

1. Site
2. Watershed/Integrator Operable Unit (IOU) (see IOU definition in Chapter 4)
3. Area

Due to the large SRS land area, large number of SRS hazards and the associated complexity in depicting current state, planned end state and alternative end states for the hazards, Figure 1.1 is provided to guide the reader through the applicable text, tables, and figures.

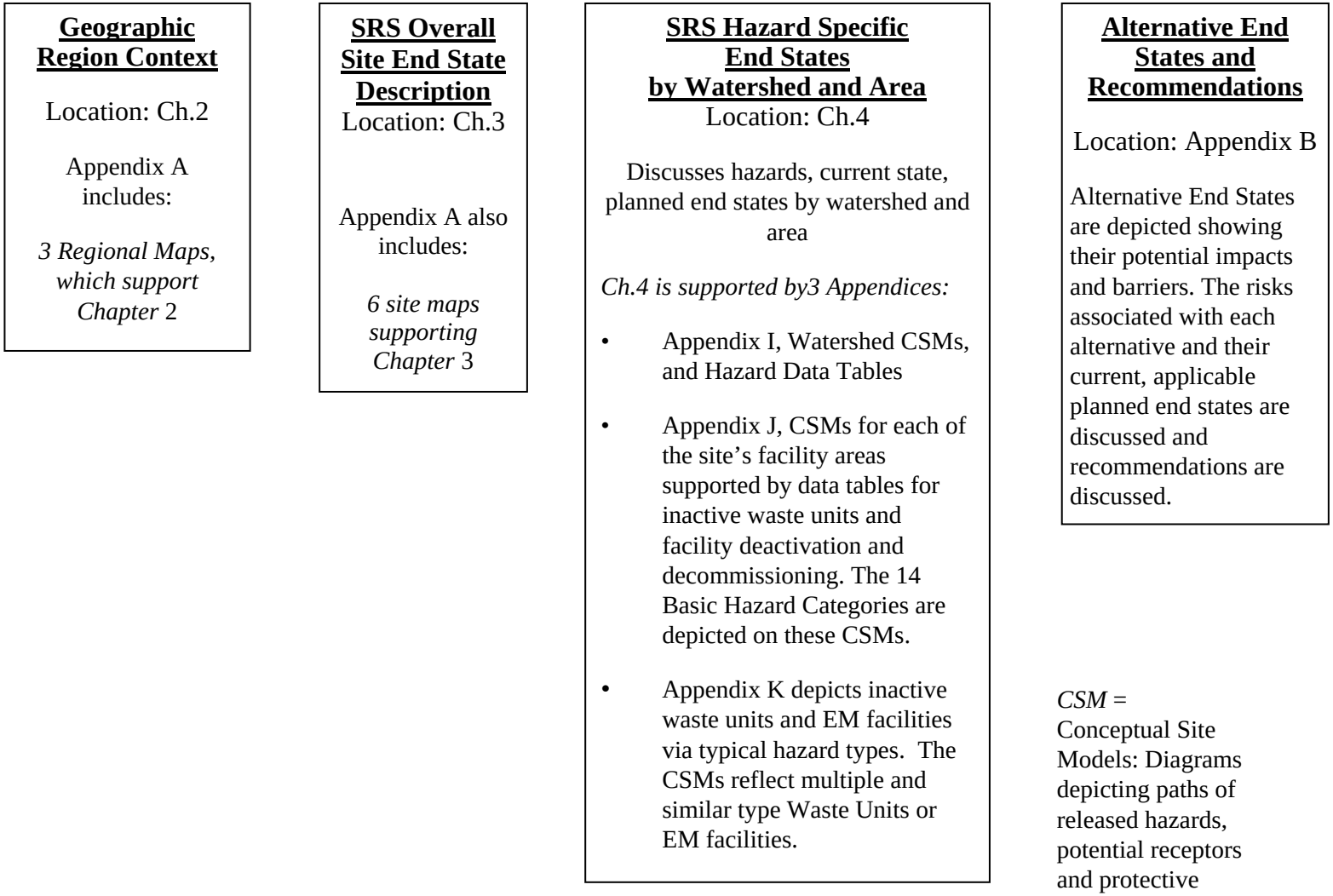

Figure 1.1 Basic Document Organization

1.3 Hazard and Risk Relationship

Risk is the chance of harm or loss. In addition, risk is utilized by a wide diversity of disciplines for a wide variety of objectives (e.g., public health, worker health, ecological, safety, economic, project related, etc.). This can easily lead to confusion. In the cleanup context, environmental laws are designed to protect humans and the environment from hazards and restore the environment to ensure human and ecological health is within an acceptable risk range. For a risk to exist, a hazard must be present, and there must be an exposure pathway to a receptor. Risk assessment is a function of the type of land use, who is exposed (what kind of receptor) and how the receptor is exposed (pathway).

Hazards are managed based on one of two approaches; the hazard is contained or the hazard has already been released to the environment. These two approaches are referred to as "hazard contained" and "hazard released."

Appendix G provides additional information regarding risk and the SRS cleanup decision process for hazards released into the environment.

1.3.1 Hazard Released

Since there is no such thing as "zero risk," Congress has defined the acceptable level of risk for cleanup of hazards. For chemicals that produce cancer (carcinogens), the residual hazard is limited to an excess lifetime cancer risk (ELCR) within 1 to 100 in a million. This is sometimes expressed as a risk range of "$10E^{-4}$ to $10E^{-6}$." If the residual risk is $10E^{-6}$, then for every 1,000,000 people that could be exposed, one extra cancer case may occur as a result of exposure to the contaminated hazard site. One extra cancer case means that one more person could get cancer than would normally be expected from all other causes. For $10E^{-4}$ risk, then there may be one extra cancer cases may occur for every 10,000 people exposed to the hazard site.

For inactive waste unit hazards (surface and groundwater units), the adverse event of a released hazard to the environment has already occurred, and cleanup is required to reduce the risk to legally acceptable levels.

1.3.2 Hazard Contained

Nuclear material, waste (radiological and non-radiological) and EM facility hazards have controls in place to contain and disposition the hazards to avoid an event that would allow a hazard exposure pathway to a receptor which could adversely impact human health or the environment. Controls are determined by assessing and characterizing the hazard and analyzing potential accident scenarios and associated consequences through various risk assessment processes (Performance Risk Assessments and Safety Basis Documents).

1.4 Site Missions

SRS was established to produce plutonium and tritium for national defense and additional special nuclear materials for other government uses and for civilian purposes. When the Cold War ended in 1991, DOE responded to changing world conditions and national policies by refocusing its mission to cleanup of the nuclear waste and environmental contamination created during production.

SRS's current mission is to fulfill its responsibilities safely and securely in the stewardship of the nation's nuclear weapons stockpile, nuclear materials, and the environment. These stewardship areas reflect current and future missions to:

- Meet the needs of the enduring U.S. nuclear weapons stockpile

- Store, treat, and dispose of excess nuclear materials safely and securely
- Treat and dispose of legacy wastes from the Cold War and clean up environmental contamination.

"Stewardship" in the context of SRS's mission is defined as "responsibility for the careful use of money, time, talents, and other resources, especially with respect to the principles and/or needs of a community."

The site's Nuclear Weapons Stewardship mission emphasizes the science-based maintenance of the nuclear weapons stockpile. SRS supports the stockpile for ensuring the safe and reliable recycle, delivery, and management of tritium resources and by contributing to the stockpile surveillance program.

The Nuclear Materials Stewardship mission is to manage excess nuclear materials, including the transportation, stabilization, storage and disposition to support nuclear nonproliferation initiatives. Primary nuclear materials in this program include components from dismantle weapons, residues from weapons processing activities, spent nuclear fuel and other legacy materials.

The Environmental Stewardship mission involves the management, treatment, and disposal of radioactive and non-radioactive waste resulting from past, present, and future operations. This stewardship includes the restoration of the environment impacted by site operations.

Of the 310 square miles or 198,000 acres the SRS covers, approximately 5,000 acres (~2.5% of the site) are defined as inactive waste units. In addition, approximately 5,000 acres (~2.5% of the site) outline the boundaries of the groundwater contaminant plumes defined within the site. The primary contaminants that are of concern in the groundwater at SRS are volatile organic compounds and tritium.

Additional details on the site's missions can be found in the *Savannah River Site Ten-Year Site Plan* (WSRC-RP-2004-00637) and the *2004 Environmental Management Program Performance Management Plan* (April 2004).

Future mission activities also include the processing of plutonium, the radioactive material that fueled one of the bombs that ended World War II and was a component of the warheads of the Cold War. DOE has indicated that the following facilities may be built at SRS:

- A pit disassembly and conversion facility
- A mixed oxide (MOX) fuel fabrication
- An immobilization facility to immobilize the remaining plutonium oxide in ceramic material

Other potential new missions for SRS include:

- Modern Pit Facility (MPF)
- Hydrogen Technologies.
- Nuclear Training Center

SRS is supporting a variety of national programs in number of areas, e.g., National Homeland Defense, Nuclear Forensics, Fusion Energy, etc. Many of these programs have potential for growth at SRS with reuse of existing facilities or installation of new facilities. Additional details can be found in the *Savannah River Site Ten-Year Site Plan* (WSRC-RP-2004-00637.)

1.5 Status of Cleanup Program

1.5.1 Cleanup Accomplished

The SRS cleanup program has been actively reducing risk across all components of the EM Program. Protecting human health and the environment is a fundamental priority of the cleanup program, and SRS efforts to reduce risk in order to maintain this protection have resulted in noteworthy accomplishments. In the mid-1990s, the site began to emphasize cleanup

completion, which resulted in the realization of significant cleanup results. This shift enabled SRS to achieve increased risk reduction. Today, risk reduction is achieved through a variety of techniques, including waste and materials stabilization and processing; waste removal and/or disposal; source term remediation or immobilization; mitigation of contamination transport and, minimizing waste generation.

For example, early in the High Level Waste (HLW) Program, it was recognized that some HLW sludge, a very high-source-term material, was contained in single-walled underground storage tanks, with a real threat that the sludge could leak from the tanks into the surrounding soil, which would contaminate that soil and potentially the groundwater under the tanks. In the late 1980s, this sludge was moved into double-walled tanks and was prepared for vitrification through the Defense Waste Processing Facility (DWPF). HLW canister production began in DWPF in 1996, and through September 2004, 1,717 canisters have been produced. Another HLW risk reduction effort was the closing Tanks 17 and 20 in 1997. These tanks were filled with grout, thereby, removing any threat these tanks posed to workers and the surrounding environment.

Considerable progress has been made toward aggressively "working off" the inventory of the various solid wastes (SW) that have been generated through years of SRS operations. Dispositioning these wastes effectively reduces the risk of release that could occur with their continued storage. Transuranic (TRU) waste resulting from nuclear material stabilization activities has been stored at SRS for years. The TRU waste poses a significant risk due to waste characterization uncertainties and the potential for the build-up of hazardous gases that could lead to an environmental release of contamination. SRS has been characterizing and processing TRU waste in order to ship this waste to the Waste Isolation Pilot Plant (WIPP).

In the 1990s, the SW program's focus broadened to include the reduction of the amount of waste that was being generated.

Accelerated cleanup and risk reduction are being achieved in the Nuclear Materials Management (NMM) Program through the stabilization and processing of nuclear materials, many of which were designated as at-risk materials in recommendations developed by the Defense Nuclear Facilities Safety Board (DNFSB). Milestones established in the *SRS Implementation Plan* responding to recommendations from the DNFSB have, in most cases, been achieved or accelerated.

SRS continues to receive spent nuclear fuel (SNF) from foreign and domestic research reactors in support of non-proliferation objectives to keep SNF secure, safely stored and protected. SNF is being consolidated to a central storage location in L Area. To date, K Area Disassembly Basin and the Receiving Basin for Off Site Fuel (RBOF) have been de-inventoried of its SNF and are either deactivated or are being deactivated. Currently, the DOE is finalizing their selection of the disposition technology to be used for SNF inventories across the DOE complex. All SNF stored at SRS is projected to be treated, packaged and shipped to the repository by the end of FY2020.

The Soils and Groundwater Project (SGP) is focusing on cleaning up contamination that exists in the environment to protect the public, the SRS workers and the environment. The cleanup methods focus on treating or immobilizing the source of the contamination to mitigate contamination transport through soil and groundwater, both on SRS and offsite, and cleaning up or slowing the movement of contamination that has already migrated to the environment.

Throughout the SGP there has been continuous improvement in technologies, regulatory

processes and project management. In recent years, remediation methods have been evolved to more efficient and cost-effective approaches, such as bioremediation, monitored natural attenuation, barometric pumping, solar-powered microblowers, and dynamic underground steam stripping. In addition, immobilizing source term material with impermeable clay caps or/and grouting waste in place are a cost-effective way to fix contamination in place while minimizing the potential to affect worker health and safety.

In the Deactivation and Decommissioning (D&D) Program, the "Assets-for-Services" concept was used successfully to reduce the footprint of facilities by approximately 71,000 cubic feet. This was accomplished for less than $1.1 million, a cost saving of approximately $10 million, when compared to the estimated cost of $11.1 million to perform the work using traditional D&D methods.

Table 1.1, Gold Metrics, provides a list of EM performance metrics being tracked by DOE to measure progress towards accomplishing final end states for certain nuclear materials, wastes, inactive waste units, and EM facilities.

Table 1.1 Gold Metrics (as of 9/30/04)

Performance Measure	Unit	Actual Completion	Life Cycle Scope*	% Complete
Nuclear Materials				
Plutonium packaged for long-term disposition	containers	1073	750	143.07%
Enriched Uranium packaged for disposition	containers	939.411	2,809	33.44%
Plutonium/Uranium residues packaged for disposition	kg bulk	400.621	414	96.77%
Depleted Uranium & Uranium packaged for disposition	MT	5,957	23,182	25.70%
Spent Nuclear Fuel packaged for disposition	MTHM	2.822	36	7.84%
Radioactive Waste				
High Level Waste packaged for disposition	containers	1712	5060	33.83%
Liquid Waste eliminated	k-gallons	0	33,100	0.00%
Liquid Waste tanks closed	tanks	2	51	3.92%
Low Level Waste/Low Level Mixed Waste disposed	cubic meters	73,443	219,526	33.46%
Transuranic Waste disposed	cubic meters	2,965	15,326	19.35%
Safeguards and Security				
Material Access Areas	areas	0	4	0.00%
Environmental Management Legacy Facilities				
Nuclear Facilities completions	facilities	6	195	3.08%
Radioactive Facilities completions	facilities	0	40	0.00%
Industrial Facilities completions	facilities	88	780	11.28%
Inactive Waste Unites				
Remediations complete **	inactive waste units	317	515	61.55%
*Information from the DOE-SR database for Gold Metrics. Lifecycle quantities will be updated as a result of additional quantities from Rocky Flats, Hanford, and inclusion of additional waste from decommissioning activities				
**Four of the 317 Release Site Completions were reopened for additional characterization during FY 2003, per regulatory agency request.				

1.5.2 End State Vision Summary

The SRS Cleanup Reform Vision is to complete the EM Closure Project by 2025.

The EM Closure Project is scheduled for completion by 2025, at which time EM will have completed its mission at SRS and will not require the use of any facilities. SRS will continue under federal control with restricted recreational and industrial/maintenance worker use, with no residential use. Production areas with no reuse plans will be cleaned to an industrial maintenance criterion. All nuclear materials and spent nuclear fuel will be dispositioned by reuse or disposal. The end state for the five SRS production reactors and three chemical separations plants, which includes the high-level waste (HLW) vitrification facility, is in-situ decommissioning unless reused to support other long-range federal missions at SRS or designated for historical preservation. Other industrial facilities will be demolished. HLW will be vitrified as a prelude to geologic disposal and the 51 storage tanks will be emptied and filled with grout. Remediation of the 515 inactive waste units, which include contaminated groundwater will be finished but may require monitoring in perpetuity, per regulators' requirements, to verify that cleanup has been achieved.

Chapter 4 addresses current status and the FY 2025 planned end state in more detail in an integrated manner with mission, facility and land use planning.

The following Figure 1.2 depicts the integrated regulatory strategy and area closure concept. It illustrates the cleanup and closure order schedule for the SRS industrial areas and the IOU completion.

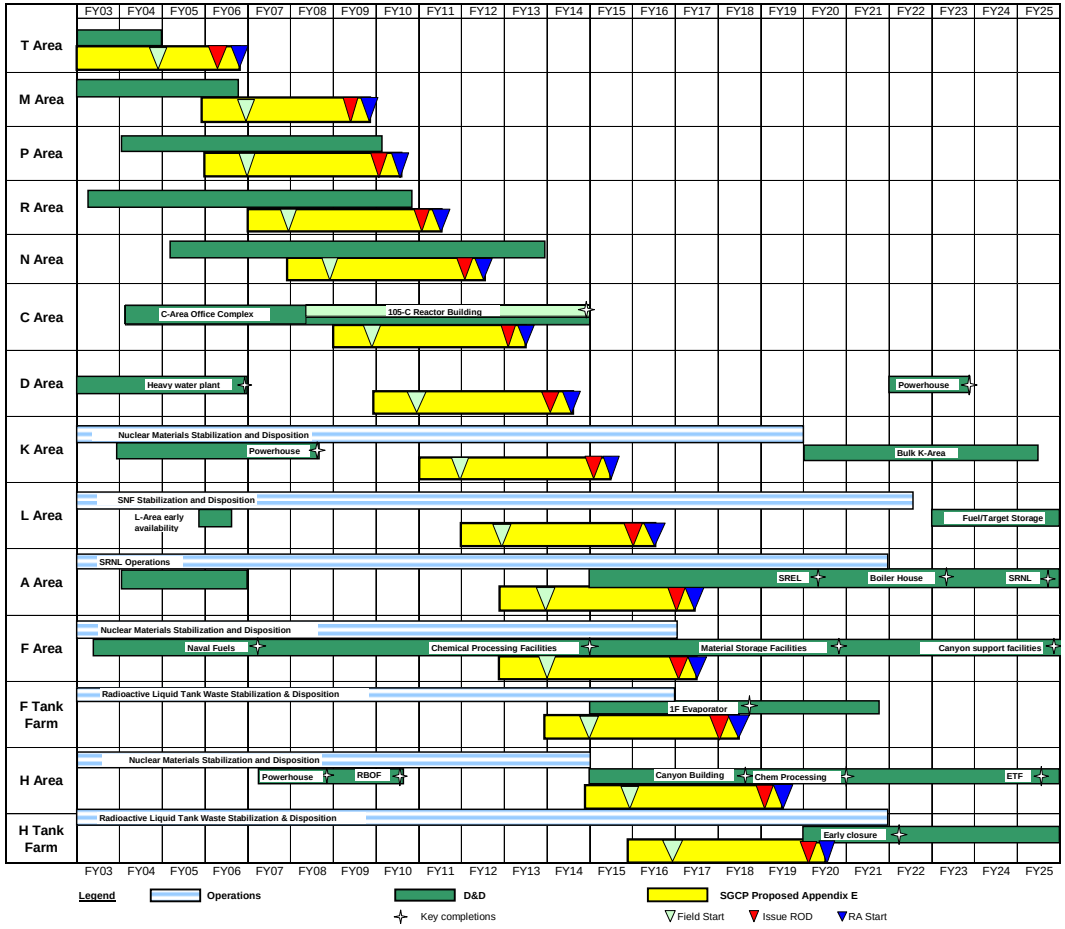

Figure 1.2 Draft SRS Area Closure Plan

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